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# Legacy

The Official Newsletter of the Amaranth Institute

## Aspects of Introduction, Manufacture, And Processing Amaranth in Russia

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Russia

I thank the organizing committee for the invitation to participate in this symposium. In this report, I would like to tell about amaranth introduction in the USSR and now in Russia. We select 3 stages of developmental work with amaranth in our country. Work with amaranth was begun in 1930 under the initiative of the academician and well-known geneticist, N.J. Vavilov. In 1940 the book New Cultures was published, where the results of research with A. cruentus and A. caudatus were described. These species of amaranth were recommended as prospective fodder crops.

The experiments were conducted in the south of the USSR, in the middle region, in Siberia and in the far east of the country. The crop of biomass reached 150 ton/ha in favorable years. Many articles were published about the advantages of amaranth as fodder. However, these works were not further developed. After Vavilov's death, the work with amaranth was stopped.

The following stage began in the 1950s when

1998 Amaranth Convention attendees, Aimes , Iowa

corn was introduced to the USSR on a large scale. In the Ukraine work was started on amaranth. Some farms grew amaranth as forages and some institutes carried out the work on the agronomy of amaranth. Amaranth was used as a culture, too, and in many gardens this culture is grown as an ornamental with beautiful flowers. However, amaranth cultivation has stopped in the fields because it is considered a malicious weed. Really, in many potato and beet fields, A. retroflexus was thrown back and could not struggle with this weed. So any work with amaranth was forbidden.

The third stage began in the mid-l980s, after our initiative about the necessity of introducing amaranth as a protein culture. Amaranth is known as having the aspartate form of C4

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## Minutes From October Meeting

October 12, 1998

Herbal Amaranth Grain 1999 Annual Amaranth Institute Meeting The meeting will be in Omaha, Nebraska on the 9th and 10th of August. The first day will be for field tours, and the second day for indoor sessions. The title of this year's meeting is Herbal Amaranth Grain. This title presents a new way of marketing amaranth grain products, and includes both the vegetable and grain amaranths which we plan to feature on the field tour. For more information reply to David Brenner, Plant Introduction, Iowa State University, Ames, Iowa, 50011-1170 USA, E-mail

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**Inside this issue:**

## October Minutes (continued)

Amaranth photo courtesy of Rodale

*(Continued from page 1)*
nc7db@ars-grin.gov. Phone 515-294-6786, Fax 515-294-4880.

**Web Page Needed**
The Amaranth Institute is seeking a volunteer to develop a web page. It would have information about meetings and contacts, and perhaps much more. Please respond to David Brenner at nc7dbs@ars-grin.gov.

**Minutes of the Amaranth Inst. Board Meeting**
By phone conference call October 9, 1998, at 4:00 PM central time. The phone costs were paid by the North Central Regional Plant Introduction Station (Brenner's employer).

| | |
|---|---|
| David Baltensperger | 308-632-1261 |
| David Brenner | 515-294-6786 |
| James Lehmann | 319-364-6876 (attended in Ames, Iowa) |
| Rob Myers | 573-449-3518 did not attend |
| Phil Sanders | 308-377-2231 did not attend |
| Jane Sooby | 308-254-3918 |
| Larry Walters | 630-369-6819 did not attend |

*"Roman Millan is seeking collaborations for joint ventures. February 19, 1999, 4:00 pm central.*

**Agenda**
Brief personal reports from all
Lehman is doing library research on heterosis
Sooby and Baltensperger report that the harvest has not started, and strong winds and rain have diminished yields. Baltensperger sees a need to narrow the row width, and improve weed control. Sooby commented on the international aspect of amaranth development.
**Officer reports**
Recording Financial Lehmann reports a positive balance of $1,160.
**Legacy** - Sooby is preparing some papers for Legacy. The editor (Walters) was not present.

Next years meeting in Omaha (9 Aug.1999 tour, 1 other indoor presentations)
Meeting room location needed - Baltensperger will seek a meeting room. We will have a field tour at the Mead station and Sooby is investigating a tour of City Sprouts in Omaha.

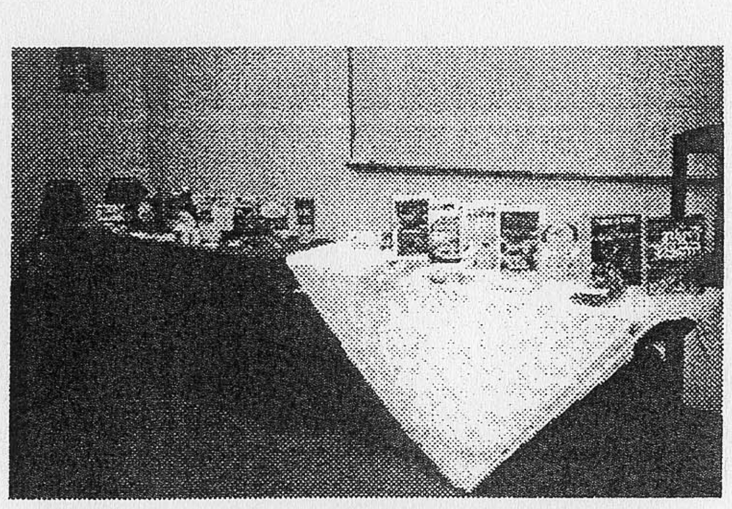
**Ideas for the program**
Lehmann suggested presentations by Elizabeth Hood (now with Pioneer in Iowa) and a scientist working with a USDA meat lab on rat nutrition. I need to ask Lehmann for the full name and address, as I did not write it clearly.

The new squalene group in Lincoln should be encouraged to attend.

**Other topics-**
The Amaranth Inst. is seeking a Web page volunteer. This could be mentioned in Legacy.
The Amaranth production guide could be available in January 1999.
**Roman Millan is seeking collaborations for joint ventures. February 19, 1999 4:00 central WRITE THIS IN YOUR CALENDAR.**

## Russia (contd.)

*(Continued from page 1)*
photosynthesis. In our laboratory, we study C4 photosynthesis and use the corn and amaranth as objects for experiments.



Caption describing picture or graphic.

Now we consider amaranth as a prospective culture in five areas: grain, vegetable, fodder, medicine, and ornamental. Amaranth has high potential in the production of organic substances and great efficiency in utilization of nitrogen. Our scientific results in regulating the intensity of c4 photosynthesis have shown that the ions of ammonium and low intensity of light inhibited the synthesis of primary acceptor of C02. The efficiency of amaranth production of biomass and protein were reduced. Therefore we recommend for amaranth producers the nitrate form of nitrogen. Now we investigate the mechanism of efficiency of utilization of nitrogen by amaranth. Hence, amaranth may be cultivated on the soils with low nitrogen content.

*(Continued on page 3)*

## Russia (contd.)

(Continued from page 2)

It is known that there was a constant problem with protein in the USSR. For the decision of this task we have offered to introduce amaranth into the agroindustrial complex of our country. In the beginning of our work we had the certain difficulties: 1. We had no equipment. 2. There was a dominant opinion that amaranth is a weed.

We have held symposiums and meetings and have gradually mastered the technology of cultivation and processing amaranth as a forage. Now the amaranth program is created and 10 universities have received state support for it. In 1990, before the disintegration of the USSR, amaranth was cultivated on hundreds of thousands of hectares in various republics of the country.

Currently, investigation are conducted with amaranth as a fodder, vegetable, and grain species. The vegetable forms are A. tricolor,; A. cruentus, and A. caudatus. The grain forms are A. hypochondriacus, A. cruentus, and A. eludis. The vegetable forms are cultivated in northern Russia, where the deficiency of protein, vitamins, and mineral elements is felt. It is possible to cultivate fodder amaranth up to 600 parallels of the northern hemisphere. The crop reaches up to ISO tons/ha of biomass. In some areas the crop reaches 250-300 tons.

Grain amaranth is growing the south and middle region of Russia. A crop produces 2-3 tons/ha of grain.

Now there are no products from amaranth at the market of Russia. This year we hope to receive our first products: bread and dry breakfast cereals. We are developing a project on deep processing of grain amaranth: protein concentrate, starch, oil, squalene, vitamin E and bran. Cost of the project is $0.5 million USA. Cur military-industrial complex is ready to build the factory for processing grain amaranth.

Thus it is possible to make the following conclusions:
1. The grain amaranth can be cultivated in the south and middle regions of Russia.
2. Fodder amaranth can be cultivated up to 600.
3. Vegetable amaranth is a prospective cultivar for all agricultural regions of Russia.
4. I think: that the actual problem for Russia is the processing of grain and biomass from amaranth.

For support of work with amaranth, I offer to create an international fund in honor of the memory of R. Rodale for the purpose of financing works on science and investment of prospective projects with amaranth.

# 1998 Choc Lol Co-Op: A Case Study in Mayan Indian Amaranth Re-introduction

Authors:
Daniel K. Early and Herbert R. Heinicke

**I Abstract**

After almost disappearing after the Spanish conquest, amaranth is making a comeback in Mexico. In the Yucatan peninsula amaranth was probably traded with the Aztecs where it was widely grown, but with no evidence of it actually being grown in this region. The Choc Lol co-op in Muna, Yucatan has chosen to reintroduce amaranth into the culture and diet of its members and to start growing amaranth in this somewhat hostile environment. Building on the experience of the Tehuacan Puebla farmers, these Mayan farmers have adopted innovative methods of cultivating amaranth based upon prehispanic techniques, but also updated with the methods and technology of today where useful and appropriate. These techniques could be generalized beyond this region to other areas of Mexico as well as to gardeners in the US and small scale farmers in other parts of the world. In claiming amaranth

(Continued on page 4)

Display of products from Amaranth Convention, 1998. Life Power Innovative Products

# 1998 Choc Lol C0-Op: A Case Study in Mayan Indian Amaranth Reintroduction (continued)

*(Continued from page 3)*
as their own, these Mayan farmers are also reclaiming an important part of their rich cultural heritage.

**II. A Brief History of Amaranth in Mexico**
Amaranth was one of the first domesticates cultivated by ancient Mexican native American farmers over 5000 years ago. They cultivated amaranth along with squash and chilies. Over the next millennium corn, beans and chia were added. By the time of the Aztec empire in the 13th century, amaranth was established as a major food staple in this area. The Mendocino Codex lists amaranth as one of the 4 major crops appropriated as tribute throughout each of the 17 provinces of this empire. The total tribute ran into hundreds of thousands of bushels. Amaranth was also the main Aztec ceremonial grain. For example, Aztecs crafted images of Huitzilopochtli the war god, and after ritual processions with the god and ceremonial singing and dancing, these images were distributed in a kind of holy communion to the peasants. The Catholic Church in 1525 began to attack Pre-Columbian religious practices and while it is tempting to speculate that this led to the decline of amaranth usage, there is no actual historical evidence to back up this hypothesis. A survey in 1577 still listed amaranth among the 4 major food crops of much of Mexico, although by 1890 amaranth is no longer mentioned.

There is no historical evidence that amaranth was actually grown in the Yucatan during this time although ancient Mayans undoubtedly knew and used amaranth because of trade and contact with the Aztecs. This report then is a case of amaranth, an ancient Meso American crop, being reintroduced into the culture of Mayan descendants and as far as can be determined, being cultivated as a crop in this particular area. Another current example of amaranth reintroduction into native communities is the project by the University of Colima to reintroduce amaranth in the Nahuatl (Aztec) community of Ticla on the Pacific coast of Michoacan.

**III. The Chac Lol Co-operative**
The Chac Lol Regional Consumer Cooperative was formed March 8, 1987 in the village of Opichen, Yucatan. Yucatan is a state in the peninsular SE part of Mexico whose NE coastline borders the Caribbean.


Amaranth Institute attendees viewing plant stations, 1998, Nebraska

The co-op, founded as a self-help organization to improve the living standards of its members, also has members in Maxcanu, Calcehtok, Muna and Ticul, all Mayan Indian Villages. The co-op also works with 25 communities in the municipo of Calakmu. These communities belong to the Regional Indian and Peoples Council of Xpujil. Each of the 5 individual sections of the co-op has its own directive assembly which govern local matters and projects within its jurisdiction The sections meet weekly and are governed by 3 elected officers, who are also members of the general assembly which meets monthly or when needed. The co-op as a whole has a board of administration and an "audit" board which run the day-to-day affairs of the co-op. The members of these administrative and audit boards are elected for 5 year terms at an annual meeting of the entire co-op. A key figure in this seemingly complicated but very democratic organization, is Rommel Gonzales, a trained Mexican anthropologist who is familiar with academia, the modern world of business and instant communications as well as the world of the struggling campesino trying to improve his meager standard of living. While his official title is president of the audit board, he is the prime mover, innovator and trouble shooter of the co-op seeing that appropriate technology is being transferred and that the co-op works at all levels.

**IV. Research & Methods**
The research for this paper was conducted by the authors during visits to the co-op in January and July, 1998 as well as an interview by Dr. Early with a representative of the Center for People's Technology and written materials provided by the Muna co-op. The Yucatan visits were arranged by Dr. Heinicke and the Iowa and Yucatan Partners of America. The Iowa group was also involved in sending a financial grant to help complete the plant nursery described later

**A. Innovative Appropriate Technology**
The co-op received technical assistance from the Center for People's Technology in Tehuacan, Puebla, Mexico which has devel-

*(Continued on page 5)*

## 1998 Choc Lol Co-Op: A Case Study in Mayan Indian Amaranth Reintroduction (continued)

(Continued from page 4)
oped ingenious methods for both cultivating and small scale farming of amaranth focusing on assisting peasant co-ops. They have formal training classes for sharing these technologies with representatives from other co-ops. The Muna co-op sent a technical representative to receive their training and then adapted Tehuacan methods to the Muna co-op's operation.

The Tehuacan innovations are based upon traditional Meso American technology with ingenious adaptations of modern materials such as plastics and polymers. The traditional technology is extremely efficient; for example, with hand harvesting, seed losses are reduced and yields can increase by as much as 50% over mechanized production. These methods are labor intensive with care being given to each individual plant. While labor costs would be prohibitive in modern agricultural methods this is not a problem in these co-ops with massive amounts of unemployed and underemployed labor. In fact this method is ideal for the Mayan co-op in providing meaningful and productive work for its members.

### B. Plant Nursery & Initial Germination

Initial direct sowing of seeds in 1996 was not very successful due to insects consuming the seeds and insufficient moisture in the fields. The Moon area of Yucatan is a dry, hot subtropical zone with an average temperature of 26 C and an average total rainfall of 860 mm. While 860 mm would not normally be considered a semi-arid region, for practical purposes it should be considered as such due to the calcarous nature of the soil which quickly drains any surface water. This and the uncertainty of when the major rains would actually start, usually in June and lasting about 2 months led to the idea of germinating the seeds in a plant nursery giving them a head start for later transplanting into the fields. The idea of giving the plants a head start goes back to the Prehispanic Aztec chinampa and the traditional Mayan raised field system in which seedhngs are grown in a bed made with enriched mud from the algae rich canals. These ancient farmers would cut the mud into little cubes, plant the seeds in the cubes which they later would carry into the fields for transplanting when the seeds had germinated. The modern Mayan farmers continue this tradition by updating with some modern methods and technology.

First of all they constructed a plant nursery which consisted of welded angle irons formed into a double frame of about 12 m long with appropriate support structures along the way. Semicircular hoops are placed at the ends and in the middle to give support for a clear plastic cover which is used at the beginning of germination and when necessary to protect from the elements. The frame is constructed so that 3 rows of trays can be placed upon the frame. The plastic trays each have 48 cups into which an amended soil mixture can be placed in each cup along with an average of 5 seeds per cup when germination is ready to begin. The amended soil mixture consists of 60% leaf mold compost 20% aged manure (usually from broiler operations), 10% lime pebbles and 10 % sand or ordinary soil.

### C. Transplanting

In 3-8 days the seeds will emerge from the moistened soil. They appear to grow slowly since most of the initial growth is in developing a root system. When the seedlings are 3-5 cm in height the 3 most vigorous seedlings are left with the weaker ones pulled and usually eaten as "greens". They are generally boiled and then fried in the same way as qualities or wild amaranth is often eaten. After thinning the plastic cover is removed to expose the seedlings to direct sunlight to prepare the seeds for transplanting to the fields. If the rains are on schedule, the seedlings are between 10-15 cm when transplanted to the fields. If the rains do not come on schedule as happened in I 998~ the farmers will transplant the seedlings from the trays to plastic bags measuring about 15 cm in diameter and 35 cm in height and perforated with 3-4 drainage holes. Generally the same amended soil mixture is used in this intermediate step along with some polymers that serve as moisture reserve for the seedlings entering into a rapid growth phase. If the rains are on schedule, the initial seedlings from the trays can be transferred directly to the fields along with some of the polymer at the bottom of the hole again to serve as an initial moisture reserve.

### D. Field Growth

Transplanting to the fields is usually done early in the morning or late in the afternoon to minimize the initial shock of transplanting from the noon day heat. To get the maximum exposure to the sun the trio of seedlings are planted I m apart in I m rows. Some areas start the adjoining row 50 cm in from the edge to form triangles rather than squares. This is not currently being done at the Muna co-op. The planting pattern allows for a density of about 10,000 plants per hectare which is also the capacity for one of the nursery units. There are currently 2 nursery units at Muna which allows some staggering of planting the seedlings during the optimum transplanting period. Whenever possible, mulching material such as dried leaves, small branches and even newspapers are placed between rows to help conserve the limited moisture.

### E. Fertilizing and Cultivation

When the plants are about 40 cm high they are fertilized with aged chicken manure by applying a handful (about 500 gms) around each cluster of plants. Then each cluster is hand cultivated building up the soil around each unit to provide support

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# 1998 Choc Lol Co-Op: A Case Study in Mayan Indian Amaranth Reintroduction (continued)

*(Continued from page 5)*

for the plants, eliminate competing weeds and allowing for maximum root development and conservation of moisture. When the plants are about 70 cm high a second hand cultivation is performed to further build up the mound around each cluster and eliminate any weeds.

### F. Harvesting

Initial harvesting begins when the plants are big enough to permit the removal of the bottom 2 leaves of the plant to be eaten as greens. Amaranth leaves are roughly equivalent to spinach and can make a significant contribution of calcium, iron, vitamin C and some B vitamins to the diet. This can be done every 15 days or so for 2 months taking the lowest leaves without apparently significantly reducing the grain yield of the plants. In 4-5 months the plants are usually ready for harvesting. The plants are hand harvested in the morning. The cuts are made about 40 cm below the top of the seed head to minimize loss from shattering. Also in some years a secondary seed head will develop permitting a small secondary crop from the same plant. The seed heads are stacked on 2 burlap bags cut lengthwise and resewn together in the middle. The seed heads are then carried on this burlap unit to a drying area where the seed heads are placed over a wooden cross bar about 5 m long with the height equal to the height of the seed heads. The bottom of the seed heads are placed on the ground with the tops resting upon the cross bar for drying. The same burlap tarp is usually placed under the plants to catch any seeds that may fall out during the drying process, which generally lasts 10-20 days.

### G. Winnowing

Seeds can be winnowed in several different ways. The ancient method of simply hitting the heads with a stick and letting the seeds fall to a tarp or ground cover is still used in some areas. An innovative method is to turn a bicycle upside down and place the dried heads in contact with the moving spokes of a wheel. With larger amounts which has not been done in the Muna co-op, animals are used to walk on the seeds or a truck driven over the seed heads. Screens are then used to separate the seeds from the chaff, which is then tossed into the wind for any remaining seeds.

### H. The Future

While a good start has been made in growing amaranth under these less than ideal conditions, many problems still remain. The best varieties) for growing under these conditions and at this latitude remains to be chosen. Approximately 100 different varieties sent to the Co-op by Dave Brenner, curator of the ISU amaranth germ-plasm center, are currently being tested Lodging or "goosenecking" of some of the current varietals has been a problem in spite of mounding up of the plants during cultivation. During the current 1998 season, they seem to be bothered with more than usual leaf damage from insects and some evidence of webbing among the seed heads. Plans are underway to install an irrigation system which will permit 2 crops to be grown per year with proper fertilization. The co-op hopes to have eventually 10 hectares of amaranth under cultivation producing a total of 125, 000 kg of amaranth. This will generate at least 2 full time positions for the co-op and livelihood for 25 peasant farmers. This will also eliminate the need to buy any amaranth from Tehuacan and vigorously promote the use of amaranth within the co-op to improve the overall nutritional level. Currently they have just started marketing an amaranth snack consisting of popped amaranth, held together with honey and flavored with nuts, raisins of chocolate within their own villages.

With continued technical help from within and from abroad, there should be a bright future for both amaranth and an improved living standard for the members of the Choc Lol
Coop.

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1997 Amaranto: Guia de Siermbra Para Zonas Semiaridas Metodo de Cultivo Intensivo Ciclo

Early, Daniel
1992 "The Renaissance of Amaranth" in From Chiles to Chocolate; Food the Ameri-

*(Continued on page 10)*

## Amaranth Growing and Processing In The Czech Republic for Czech Republic

Author:
Jitka JAROSOVA
Bohemia Amaranth Inc.
779 00 Olomouc, CZECH REPUBLIC

INTRODUCTION
The tradition of amaranth growing in the Czech Republic Is dating back about one decade ago. Bohemia Amaranth Inc. is a private company established in 1994 to promote amaranth growing, breeding, processing, marketing and research.

GROWING CONDITIONS
In the Czech Republic, amaranth is grown on the total area of 550 hectares mostly in warm, dry regions. It is recommended to start sowing in the beginning of May. Nevertheless, subsequent cool periods may cause poor emergence and seedling growth accompanied by heavy weed infestation. Seed harvest is often hampered by wet and windy weather, sometimes early frosts may occur. In this context, amaranth crop is considered more risky as compared to cereals and other seed crops.

CULTIVARS, YIELDS
The best-yielding and most frequently grown cultivars are as follows:

1. OLPIR, A-2OO D, MONTANA 3 (Amaranth cruentus L.)
2. Hybrids K-433, K-432, KONIZ, DAKOTA (A.hypochondriacus x A.hybridus)

There are annual fluctuations in amaranth seed yields among various genotypes due to unstable weather conditions, but also owing to wrong cultural practices. Average yields are ranging between 2.5 m 3.1 tons per ha.

PROCESSING
In the past 3 years there has been an increasing demand for amaranth whole grain flour. The range of products comprises a variety of breads, cookies, biscuits, pretzels, crackers, pasta, extruded products, Instant mixes etc.

RESEARCH PROJECTS
The company Bohemia Amaranth Is participating in the following national research projects:

1. An effect of different locations, cultivars and cultural practices on amaranth seed yield and quantity (1997-2000)
Project coordinator: South Bohemian University, Ceske Budejovice.

**Goals:**
⇒ compare seed yields and quality of 10 amaranth cultivars grown In 3 different regions
⇒ specify optimum cultural practices (plant stand density, weed control, harvest dates and technology) suitable for conventional and ecological farming systems.

2. Amaranth as part of health foods (1996-1999)
Project coordinator: Charles University School of Medicine, Hradec Kralove

**Goals:**
⇒ perform a clinical study focused on amaranth administration as part of gluten free diet In celiac patients
⇒ assess the impact of amaranth on blood fat level and Its ability to control risk factors In atherosclerosis.

## Yield and Canopy Development of Seven Species of Amaranth harvested at Different Developmental Stages

Author:
Byron Sleugh*, K.J Moore, and J.R. George

Few plants have cultural or historical origins comparable to the Amaranthaceae family. Amaranths are noted for their high tolerance to arid conditions and poor soils where most other crops cannot grow. Numerous studies have shown that amaranth has nutritional qualities superior to those of common cereal and forage crops, with some grain types having protein levels ranging from 13-38%. When the high quality of amaranth is combined with its agronomic productivity, it compares favorably with the more commonly utilized crops and could possibly be used as a forage alternative.

The objectives of this study were to evaluate the forage yield and quality of various amaranth accessions and determine the relationship between leaf area index (LAI), yield and, quality.

Plots of seven accessions from the North Central Plant Introduction Station were established in June 1997 at the Iowa State University Sorenson Research Farm near

*(Continued on page 8)*

# Yield Canopy (contd.)

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Ames, Iowa. Three replicated plots of each accession were established in a randomized complete block design. Starting four weeks after transplanting, subplots were harvested at a height of 5 cm at two-week intervals to determine forage yield. The main effect of accession and harvest was significant (<O.O5) for yield and LAI, but the interaction was not. Amaranthus hybridus (Greece), had a significantly higher yield (3359 kg ha') than all the other accessions and A. cruentus Mexico) had the lowest (2347 kg ha) Amaranthus hybrid (?Pueblo, Mexico) and A. hybridus (Greece) had the same LAI (2.6). A. cruentus (Zimbabwe) and A. cruentus Rwanda) were also equal (2.2), as were A. hybridus (Zambia) and A. Hypochondriacus (Colorado) (1.8). A. cruentus Mexico) had the lowest LAI (1.1). Ten weeks after transplanting, within a species, LAI was maximized and did not change for the remainder of the season.

Based on the high yields and rapid early growth, amaranth could make a good forage or late season alternative crop.

# Excretion and Dye Properties of Dye Stuff From Amaranth Bracts

Author:
Kadoshnikov S.I., Matrirosyan D.M., Tchernov I.A., Kulikov J.A.

Kazan State University, Kazan, Russia.

Grate need for natural food dye stuffs does an actual searching for vegetable raws, containing quite a number of natural pigments and development of economical technologies of their separation. One of the best plants, for it effect is Amaranthus cruentus. Lehmann at al. and Lehmann reviewed the status and prospect for use of the betacyanine pigment amaranthine in consumer products. Huang and Von Elbe excreted amarantine from the leaves of A.tricolor, described it chemically, and found it to be comparable in most respects to betanine. Right now getting the dye stuff from the amaranth becomes actual in connection with the increasing use of this plant as a new product and corn culture, that creates real promises to the development of raw base.

While excreting organic compoins from vegetable raws scientists researchers come across a problem of the most full excretions.

For the separation of the dye stuff from whisk brooms of ama-
ranth we used the method of repercolation in percolatorts

## Excretions (Continued)

battery.

For this method the battery of 3 to 5 and more percolators is used. The essence of this method is that raw material is divided into portions and each following portion is excreted (percolates) by the extract, received from the previous one. Thus maximum use of dissolving ability of the extract is achieved. Since weak extracts have its reserve and can extract real materials from the raw material. A number of extractors in battery and time of infusion in each percolator are to pro-vide a possibility of full saturation of the extract to a moment of getting ready extract and fill exhausting raws in first. This method allows to get concentrated extracts without vaporization. During the first stage of separation of the dye stuff it is necessary to define an optimum amount of extractors in the battery for the full extract raws and maximum saturation of the final extract by the dye materials. Besides, a number of parameters, that are required for further optimization of an excretion, such as a factor of deduction of the solvent by the raw material, density and refraction factor of getting extract is set up Spectral investigation was conducted. Coefficient of deduction of solvent by the raw material is calculated. Calculations were computed by applying the following equation:

$$K = \frac{V(0)-V}{m} \quad \text{,where}$$

K is a deduction factor, V(0)- a volume flood in the extractor of solvent ml, V is a volume of received extract, ml, m is a mass raws in g extract. Average value K, received in the second experiment forms a value 4.6 ml/g. It proves the fact that each gram of extract raws absorbs and retains 4.6 ml of extract. The received data is required for determining correlation of the extract to extract material in the given percolatorts battery and for the evaluation of the necessary amount of the solvent. Concentration of the dye stuff in the investigated extracts has been defined by spectral method applying the value of optical absorption in the maximum of absorbing the dye stuff a t the wavelength of 530 nm. For this concentration of dry materials in the solution the dye stuff was determined first and accurate (calibrate) curved dependence of absorbencies in the maximum of absorbing the dye stuff from its concentrations was drawn. Besides this method, concentration of the dye stuff in the investigated solutions it is possible to evaluate the value of density of the solution (p) and the value of the refraction factor (n). Below the data of dependence of these parameters from concentrations of the dye stuff; allowing to evaluate this concentration are For the practical goals it is interest to get an extract with the maximum contents of the dye stuff; to avoid a process of further concentration. So the experiment on the accumulation of the dye stuff in the extract with the following excretion of new portions of raws by the extract. Received from the preceding extractor was carried. It would have solved the problem of the amount of extractors in the battery from the point of view of getting an extract with the maximum contents of the dye stuff. From these data it follows that with the increase of the amount of the extractors in the battery up to 8 concentrations of the dyestuff in the extract increase, going to the plateau

## Excretions (Contd.)

*(Continued from page 8)*

nd reaching the values of the second experiment (4.88%). However, with the concentration of the dye stuff in the second wash off 8 rows is concentrations of the dye stuff in first wash out Irons. It makes possible adsorption's of the dye stuff on the fresh raw material in the last extractor and saturation of solution as a result of alteration of extract abilities of the used solvent. Analyzing the received results, we can conclude that the increase of concentrations of the dye stuff final extract by increasing an amount of extractors is not expedient because of the second absorption of the dye stuff from concentrated solution made of the raw material The dye stuff study spectral, received from amaranth bracts by the repercolation method in the battery having 9 percolators was carried out. The influence of p11 medium of dye stuff solution on its
spectrum of absorption was studied. For this purpose solution was dissolved 80 times and 3 samples were made:
1. sample (pH =2).H3P04 is added to the source sample.
2 samples (pH =5). Source sample.
3 samples (pH 8). KOH is added to the source sample.
While comparing spectrums absorbing the dye staff with different values pH it is important to mention different correlation of maximums of absorption. Probably, this reflects a different correlation of oxidized and restored forms of the pigment, having, several excellent spectrums of absorbing in registered area of long waves.

Besides, this is indicated by changing of a location of short wave maximum of absorbing shift within 10 nm. m the field of 385 395 nm.

Conclusion

1. It is shown that full exhaustion of raws at excretion of the dye stuff approaches after fifth excretion, but after the third excretion an amount of secreted from raws of the dye stuff forms 96.8%.
2. Concentration of the dye stuff in the ready made product may be registered in several ways. Spectral way, registers, concentration according to the density of the extract and the coefficient of refraction.
3. Color of the dye stuff and its spectrum of absorption, depend on the correlation of oxidized and restored forms of the pigment, defined extragent's pH.

## The Productivity of Nutritious Value of Green Biomass in Amaranthus Cruentus L. as Affected by Different Forms of N-Fertilizers

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The question of insistence of amaranth to a mineral nutrition and its responsiveness to fertilizers is quite debatable, first of all because of a lack of an experimental data. The preferable form of N-fertilizers for amaranth is also poorly investigated. In experiments with Knop solution, it was established that the use of NH4 as a sole source of N causes a sudden delay in growth of A. paniculatus, a decrease in the photosynthetic activity and productivity of green mass and protein content (Nikitin, Tischenko, 1989,1991 Magomedov et al , 1996). in field experiments, it was shown that at 105 and 740 kg N/ha, the responsiveness of A.retroflexus on NO3- form was better and at 340 and 1460 kg N/ha the efficiency of NO3- and NH4+ - fertilizers was comparable (Bachthaler 1988).

Since 1987, at the Botanical Garden of Kazan University, introduction research has been carried out in relation to the optimization of mineral nutrition for amaranth in the climatic conditions of the Middle Volga. region. The correct choice of forms of N-fertilizers is of great importance. This is especially in connection with two circumstances. These are a slow initial period of development and the different effects of forms of mineral N on the photosynthetic metabolism of C3andC4plants

For the past ten years, a series of lab, greenhouse and field experiments on the cultivation of A. cruentus have been carried out. As a result of introduction, this species of amaranth has been recommended for cultivation for the purpose of fodder in the region of the Middle Volga. These experiments were carried out on non-fertile soddy podzolic and grey forest soils. The influence of easy-soluble NaNO3, NH4NO3, CO(NH2)2) and long-term (carbamide-formaldehyde - CFF) forms of N-fertilizers on the productivity and quality of green mass of amaranth was studied. The N-regime and microbiological characteristics of soils were also studied. At the same time, the influence of these forms on infiltration losses of N-fertilizers was investigated. It was established that, on these soils, the effectiveness of both easy soluble forms was comparable. However, some parameters were better in case of NH4N03. Application of moderate doses of both forms of N (0.1 g N per kg in a greenhouse, 120 kg N per ha in a field conditions) were accompanied with a rise in biological activity in the soils. These were comparable with infiltration losses of N and accumulation of N()3 in the green mass. The use of NaNO3 was not ecologically safe and was accompanied by an in-

*(Continued on page 10)*

## N-Fertilizers (Contd.)

crease in infiltration losses of $NaNO_3$ (1.4 - 2.3 times) and an accumulation of nitrates (1.6 - 1.9 times) in the green mass of amaranth on both types of soils. Using CFF instead of carbamide in moderate doses (0,1 g N/kg) reduced the productivity of amaranth by 11-13% and its uptake of N by 10-19% However, it considerably slowed down transition of nitrogen to $NO_3^-$ form in the soil, reduced the accumulation of nitrates in the green mass 2-3 times and reduced infiltration losses of N from soddy podzolic soils 3 times. Thus on non-fertile soils in the Middle Volga region, the forms of N-fertilizers rendered some influence on productivity and quality of the green mass of Amaranthus cruentus L. however, a much greater influence of weather conditions (air temperature during vegetation period and humidity during the first 30 -50 days) was observed.

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*(Continued from page 6)*

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Amaranth Institute Attendees viewing a field grown by Phil Sanders, NE.

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*1997 Legacy, Vol. 9 ("Plainsman" variability, blister beetles, China Tour)

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Note:
The 1998 Amaranth Institute meeting was in Sidney, Nebraska.